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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/712,810	11/13/2003	Richard A. Blanchard	GS 160 D1	8845

27774 7590 10/18/2006

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EXAMINER	
LE, THAO X	

ART UNIT	PAPER NUMBER
2814	

DATE MAILED: 10/18/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/712,810	BLANCHARD ET AL.	
	Examiner	Art Unit	
	Thao X. Le	2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *14 September 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *24-41* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *24-41* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Allowable Subject Matter

1. The indicated allowability of claims 24-26 is withdrawn in view of the newly discovered reference(s) to Kubo (6395604). Rejections based on the newly cited reference(s) follow.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

4. Claims 24-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 6395604 to Kubo et al in view of US 5216275 to Chen.

Regarding claims 27, Kubo discloses a power semiconductor device in fig. 24 comprising: a substrate 20 of a first conductivity type (N); a voltage sustaining region 21 disposed on said substrate 20, said voltage sustaining region 21 including an epitaxial layer 21, col. 7 line 11, having a first conductivity type (N); at least one terraced trench 23, fig. 13(E), located in said epitaxial layer 23; said terraced trench having plurality of portions that differ in width to define at least one annular ledge therebetween; a filler material 40/424/25 substantially filling said terraced trench; and at least one active region 22/27 of said second conductivity P disposed over said voltage sustaining region 21 to define a junction therebetween.

But, Kubo does not disclose at least one annular doped region having a dopant of a second conductivity type, the annular doped region being located in the epitaxial layer below and adjacent to the annular ledge.

However, Chen discloses a power semiconductor device in fig. 6 comprises a n-type substrate 4, a n-type epitaxial layer 5 a trench having either n or p-type conductivity region 6, col. 5 line 55, in the epitaxial layer 5. At the time the invention was made; it would have been obvious to one of ordinary skill in the art to use the doping teaching of Chen with Kubo's device, because it would have created a device with better on-voltage and breakdown voltage as taught by Chen in col. 1 lines 58-63.

Regarding claims 28-29, Kubo discloses the device wherein said plurality of portions of the terraced trench includes a smallest width portion and a largest width portion, said smallest width portion being located at a depth in said epitaxial layer such

that it is closer to the substrate than a largest width portion, fig. 13(E), wherein said plurality of portions of the terraced trench are coaxially located with respect to one another, fig. 13(E).

Regarding claims 30-31, Kubo discloses the device wherein said plurality of portions of the terraced trench includes at least three portions that differ in width from one another to defined at least one annular ledge.

But, Kubo does not disclose the device wherein at least one annular doped region includes at least two annular doped regions.

However, Chen discloses a power semiconductor device in fig. 6 comprises a n-type substrate 4, a n-type epitaxial layer 5 a trench having either n or p-type conductivity region 6, col. 5 line 55, in the epitaxial layer 5. At the time the invention was made; it would have been obvious to one of ordinary skill in the art to use the doping teaching of Chen with Kubo's device, because it would have created a device with better on-voltage and breakdown voltage as taught by Chen in col. 1 lines 58-63.

Regarding claim 32, Kubo discloses the device wherein said epitaxial layer has a given thickness and further comprising the step of etching a first portion of the terraced trench by an amount, fig. 14B, col. 4 lines 22-35.

But, Kubo does not discloses the etching is substantially equal to 1/(x+1) of said given thickness, where x is equal to or greater than a prescribed number of annular doped regions to be formed in the voltage sustaining region. However, Kobo discloses the trench has specific dimension, col. 4 lines 22-35. According, it

would have been obvious to one of ordinary skill in art to the trench etching of Kubo in the range as claimed, because it has been held that where the general conditions of the claims are discloses in the prior art, it is not inventive to discover the optimum or workable range by routine experimentation. See In re Aller, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955).

Regarding claims 33-34, Kubo discloses the power semiconductor device wherein said material 24 filling the trench is a silicon dioxide dielectric material, col. 7 line 17.

Regarding claim 35, Kubo does not disclose the dielectric material is silicon nitride.

However, at the time the invention was made; it would have been obvious to one of ordinary skill in the art to replace the layer 24 with silicon nitride material, because both silicon dioxide and silicon nitride can be used interchangeably as a dielectric and would have been considered a mere substitution of art-recognized equivalent values, MPEP 2144.06.

Regarding claim 36, Kubo does not disclose a dopant is boron. However, as discussed in the claim 27 above, Chen discloses the layer 6 can be N or P-type doping. Thus, using boron for P-type conductivity or phosphorus for N-type doping is standard in the art.

Regarding claim 37, Kubo discloses the device wherein a surface area of the at least two annular ledges are substantially equal to one another.

Regarding claims 38-39, Kubo discloses the device wherein said at least one active region further a gate dielectric 24 and a gate conductor 25 disposed above said gate dielectric 24; first and second body regions 22 located in the epitaxial layer 21 to define a drift region therebetween, said body regions 22 having a second conductivity type (P type); and first and second source regions 26 of the first conductivity type (N) located in the first and second body regions 22, respectively, fig. 24, wherein said body regions include a deep body regions 27, fig. 24.

Regarding claims 40-41, Kubo does not disclose the device wherein said terraced trench has a circular cross-section or cross-sectional shape selected from the group consisting of a square, rectangle, octagon, and a hexagon.

However, Chen discloses the device wherein said trench has a circular cross-section or cross-sectional shape selected from the group consisting of a square, rectangle, octagon, and a hexagon, fig. 3. At the time the invention was made; it would have been obvious to one of ordinary skill in the art to use the cross-sectioned shape teaching of Chen with Kubo's device, because it would have created a device with better on-voltage and breakdown voltage as taught by Chen in col. 1 lines 58-63.

With respect to claim 24-26, as discussed in the above claims 27-41 the combination of Kubo and Chen disclose all the limitations of claims 24-26. Furthermore, **all the process limitations** in claims 24-26 do not carry weight in the device or structure claims. In re Thorpe, 277 USPQ 964 (Fed. Cir. 1985).

Response to Arguments

5. Applicant's arguments with respect to claims 27-41 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thao X. Le whose telephone number is (571) 272-1708. The examiner can normally be reached on M-F from 8:00 AM - 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael M. Fahmy can be reached on (571) 272 -1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

13 Oct. 2006

THAO X. LE
PRIMARY PATENT EXAMINER